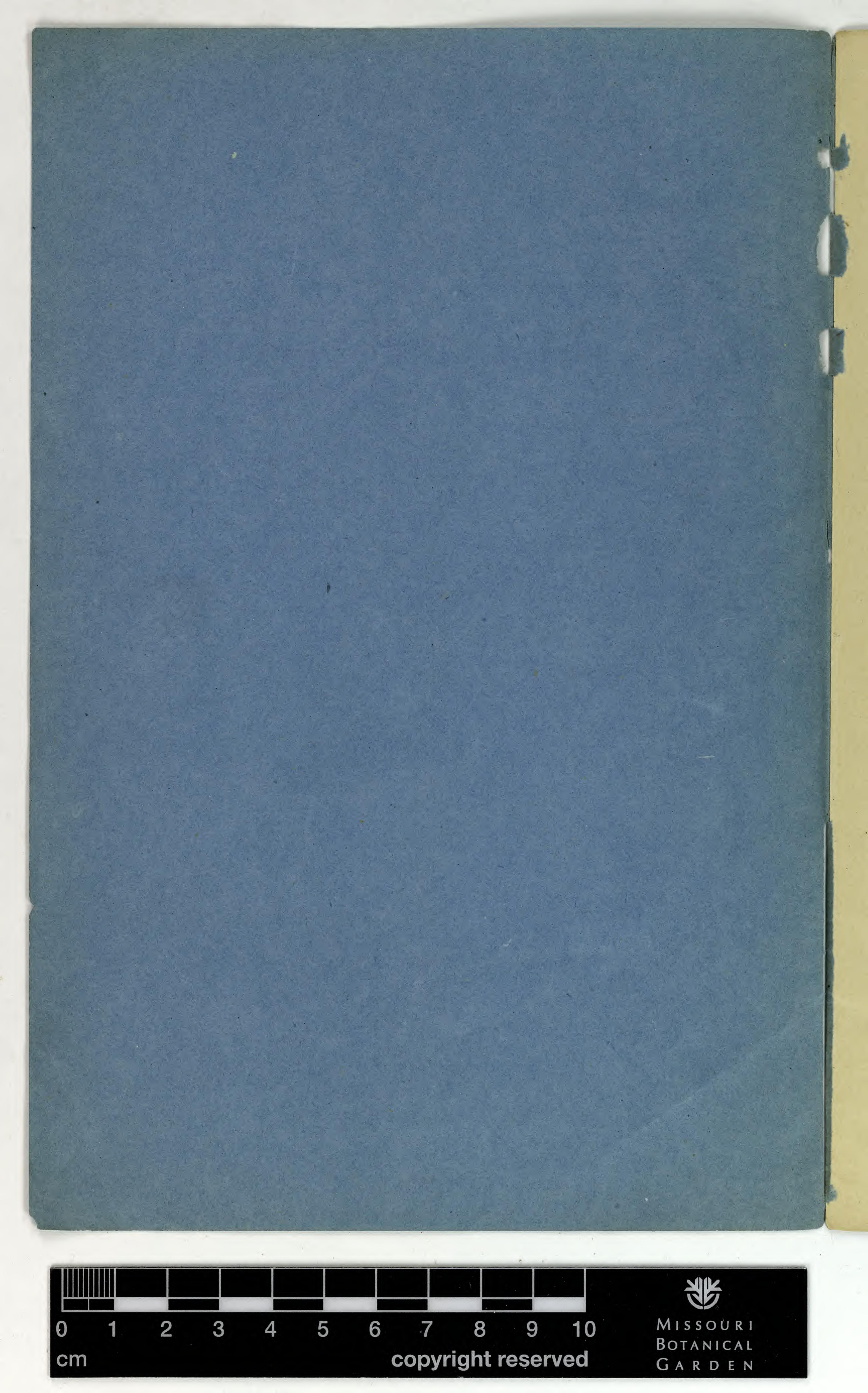


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(From the Transactions of the Academy of Science of St. Louis, Vol. III., No. 4.)

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## The Flowering of Agave Shawii.

By Dr. GEORGE ENGELMANN.

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July 8-Sept. 5	27\frac{1}{4} in.	19½ in.	46¾ in.		

The table shows that the night-growth (including the morning hours) was in every decade larger than the day-growth, and in the whole period surpassed it by 16 p. ct., the former amounting to 58, the latter to 42 p. ct.

It is further seen that the largest advance was made about the middle period, or from the 3rd to the 5th, and mostly in the 4th decade. After Sept. 5th the growth diminished rapidly, about the end of the month the head began to swell, and 3 months later the first blossoms opened.

The table also proves that the temperature of each decade did not have any material effect on the growth of the stalk; in the warm weather of the first two decades it grew much less than in the cooler 3rd period.

[Nov., 1877.]



The largest growth in 24 hours, 1½ inches, took place in the 4th decade, Aug. 10th-11th, mean temp. 78°; while on Aug. 18th, with mean temp. 84°, the growth is marked only ½ inch, and Aug. 23rd and 25th, mean temp. 85°, it amounted to 1 inch and ¾ inch respectively.

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The full-grown scape measured 54 inches to the base of the panicle, which, when fully developed, was itself 21 inches long and a little wider, and consisted of 19 branches, the lowest ones the longest, somewhat S-shaped, and horizontal, with the end turned up.

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Abundant opportunity was afforded to study the gradual development of the flowers (see also p. 298). I have, on Plate IV., represented these various phases by a series of figures carefully drawn from nature.

The bud bursts in the morning or in the middle of the day (Fig. 4); the bent filaments begin to straighten out, the still closed anthers commence to protrude, the top of the style has not yet reached the tip of the perigonial lobes. Only thus far the perigon and its lobes are fresh, exhibiting their fullest development.

In the evening of the same day the filaments are straightened out above the perigon, the anthers begin to open at the upper and lower ends, as Fig. 6 shows, and then all along their commissures; the style has not yet reached the length of the filaments, but the perigonial lobes are already withering at tip.



On the 2nd day the anthers are shrivelled, though quantities of pollen remain adhering to them; the perigon withers more; the style in the morning is still shorter than the filaments, but in the evening has exceeded their length somewhat; the stigmatic lobes remain entirely closed.

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On the 5th day the style has reached its full development, 2\frac{1}{4}-2\frac{3}{4} inches longer than the wilted perigon; the filaments are drooping, the anthers shrivelled, much pollen yet adhering to them; the stigmatic lobes have separated and are covered with a large drop of sweet, glutinous stigmatic liquid, which causes the pollen grains that drop into it to develope their long tubes (Fig. 8).

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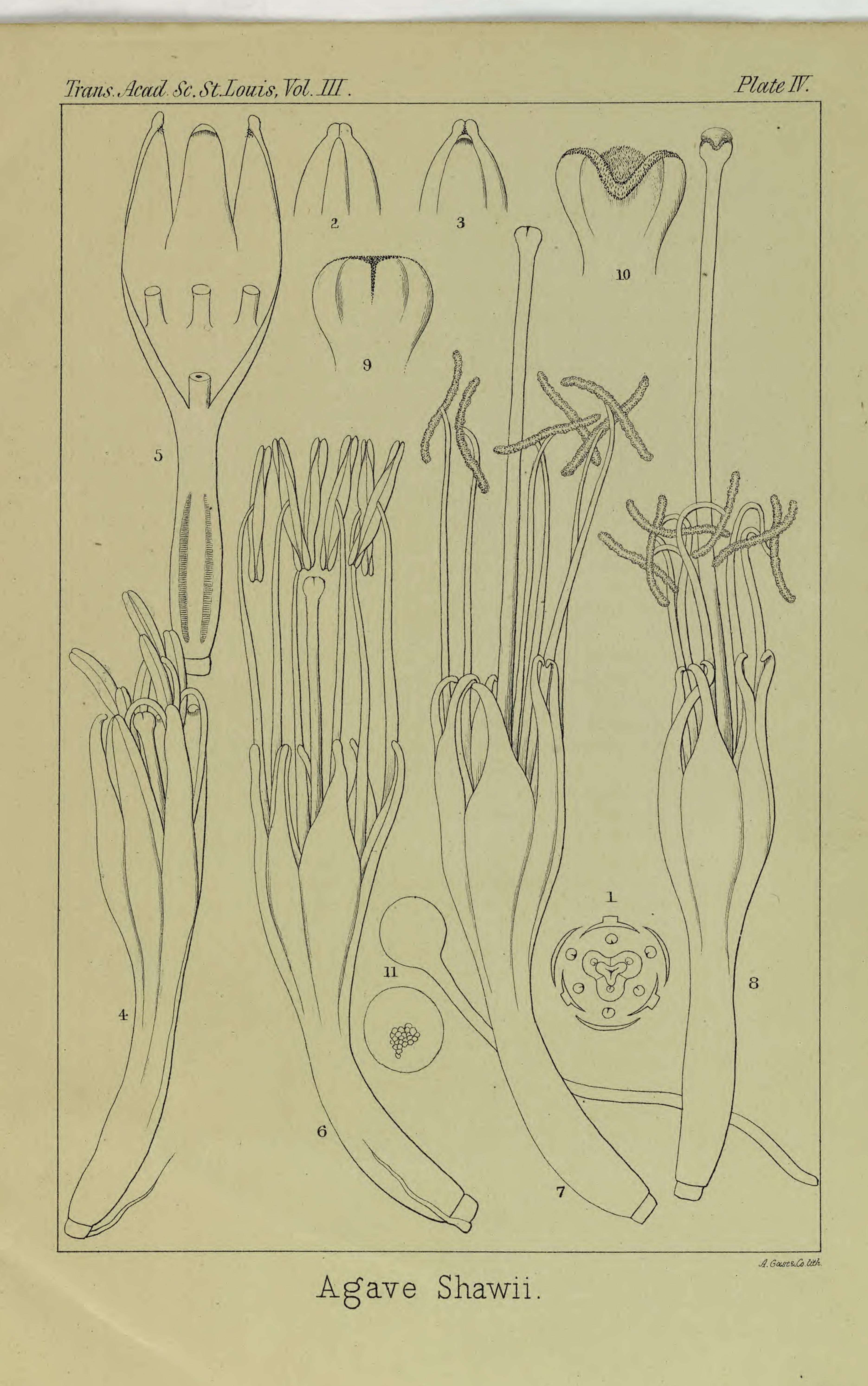
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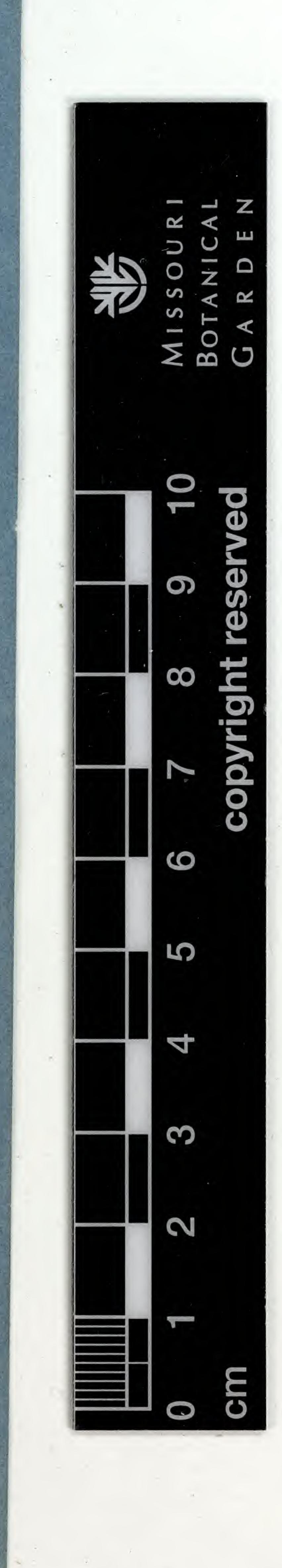
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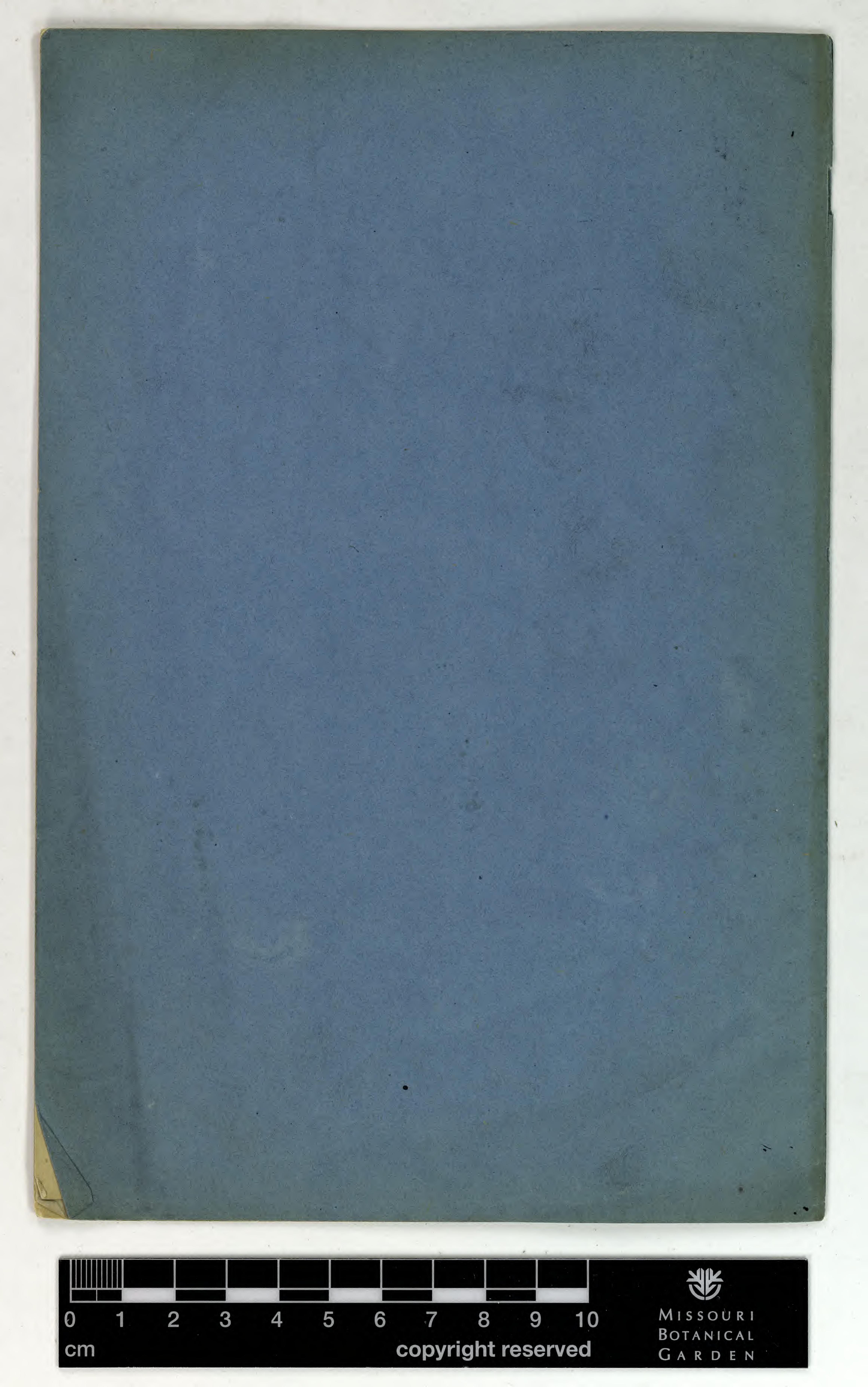
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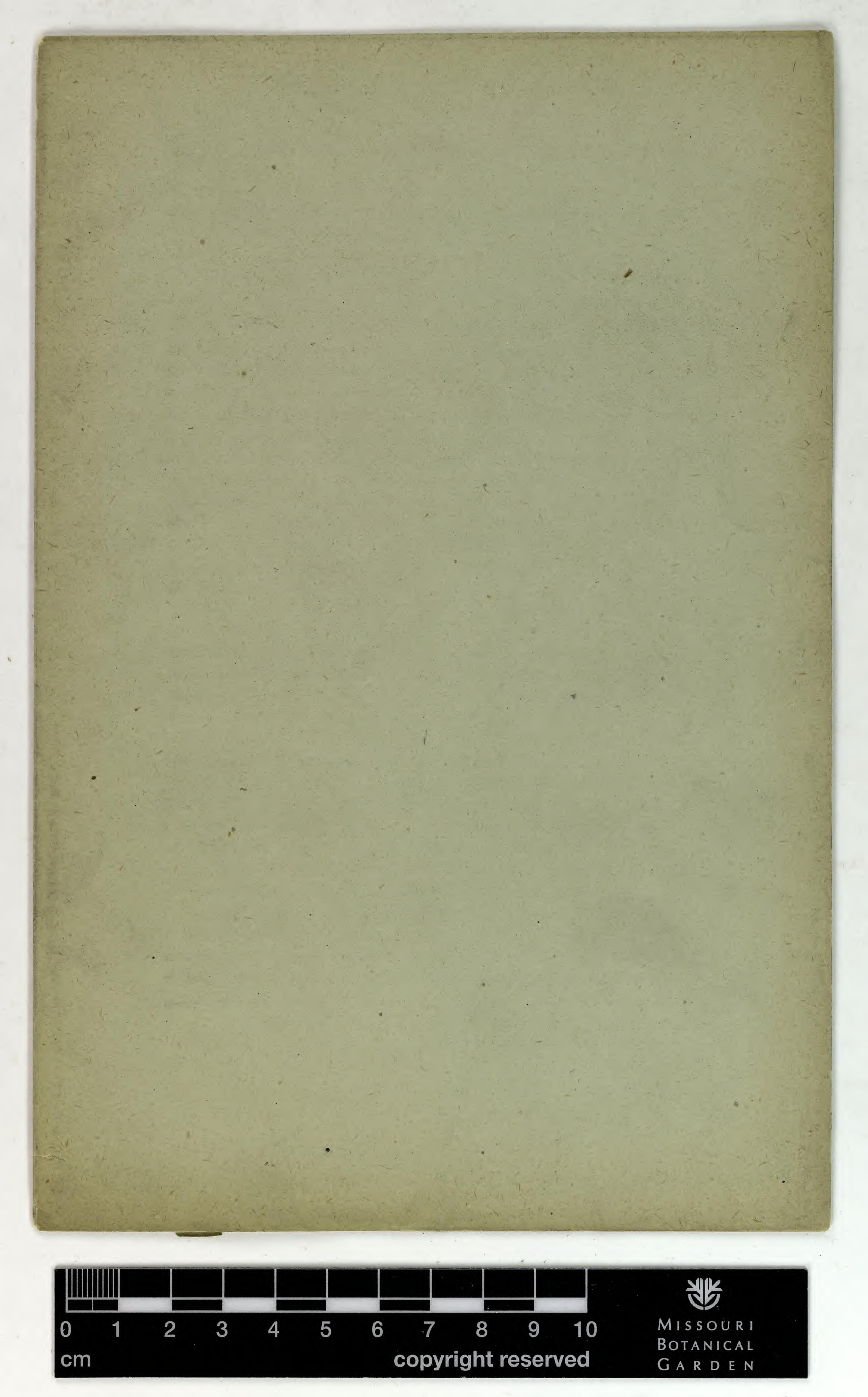
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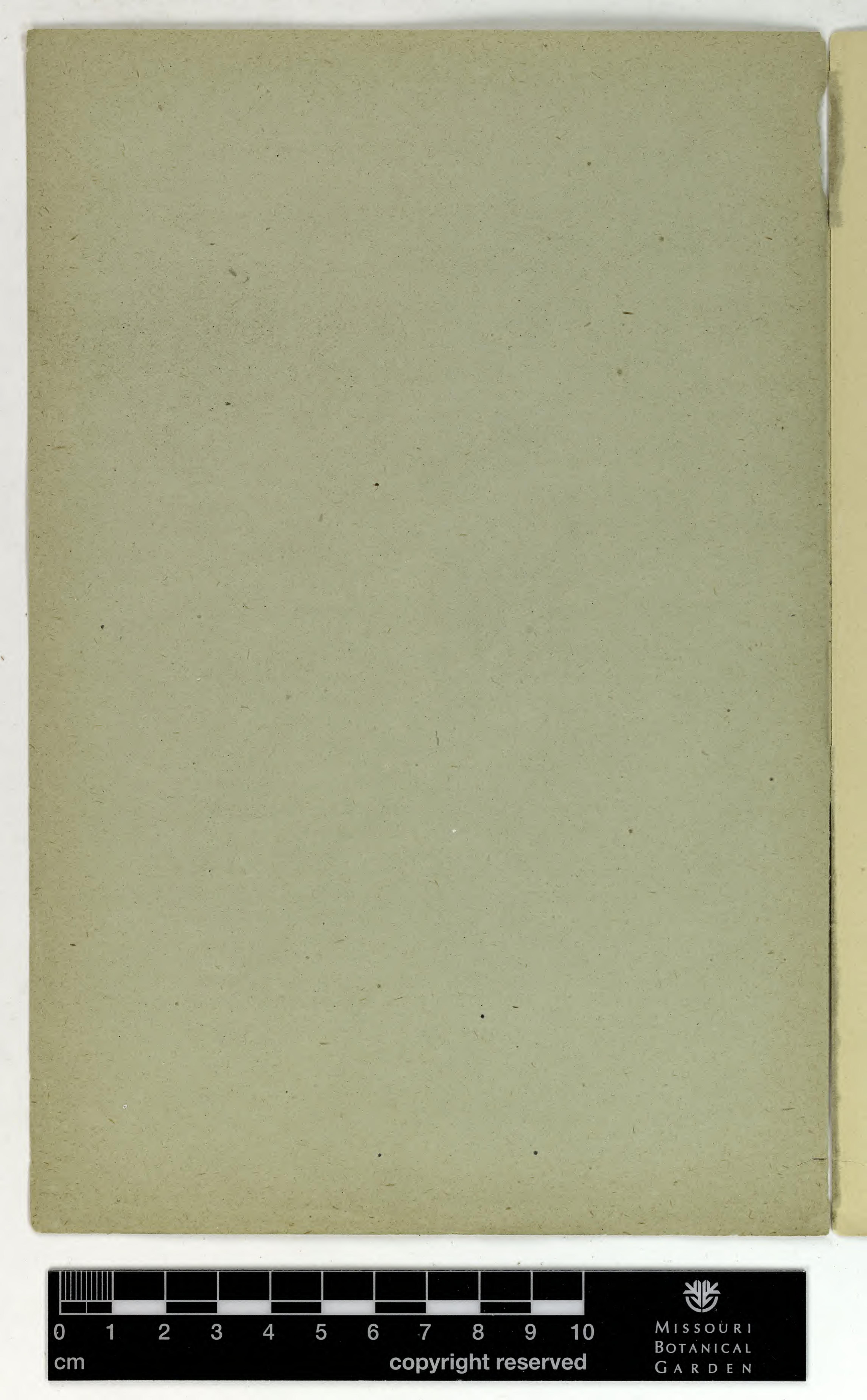
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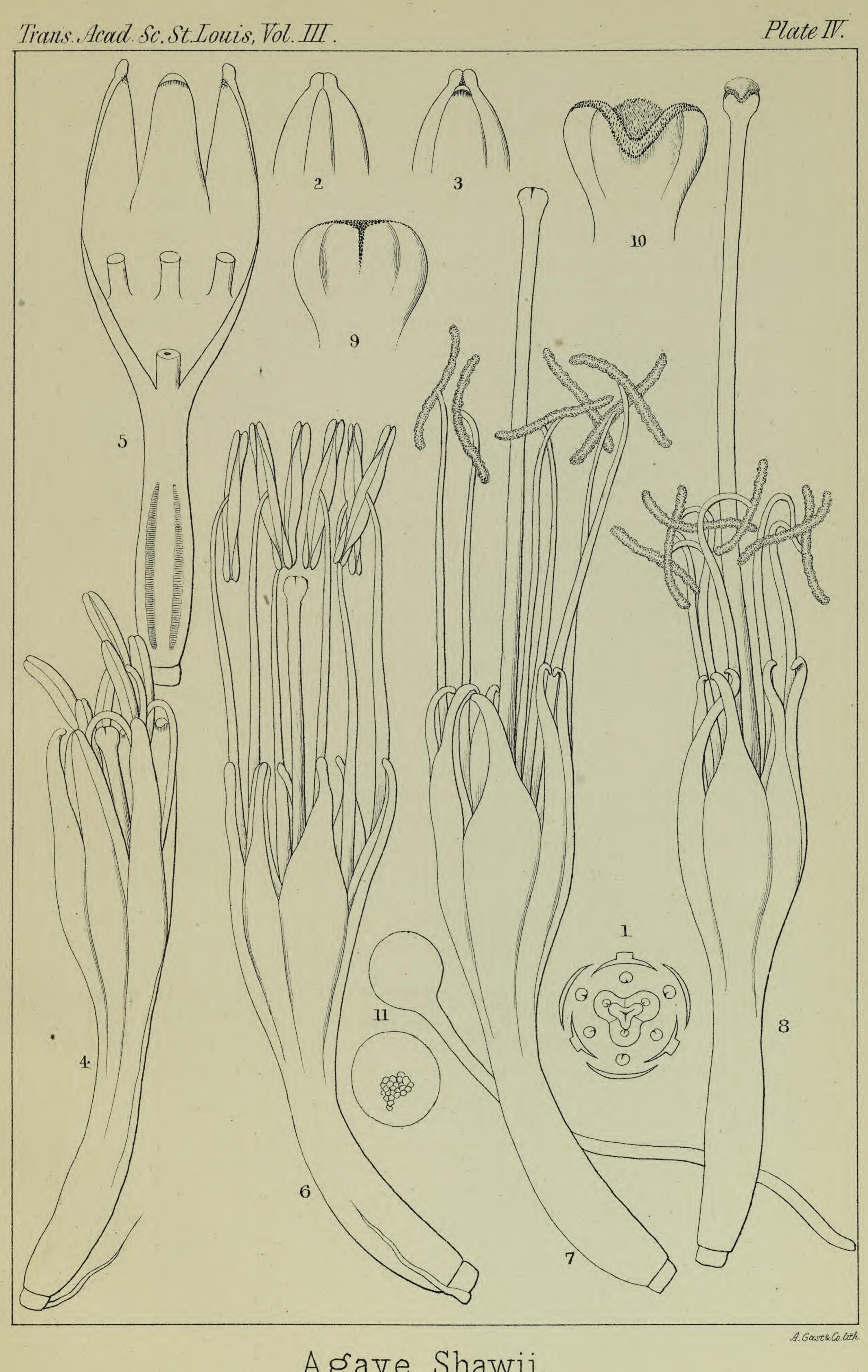
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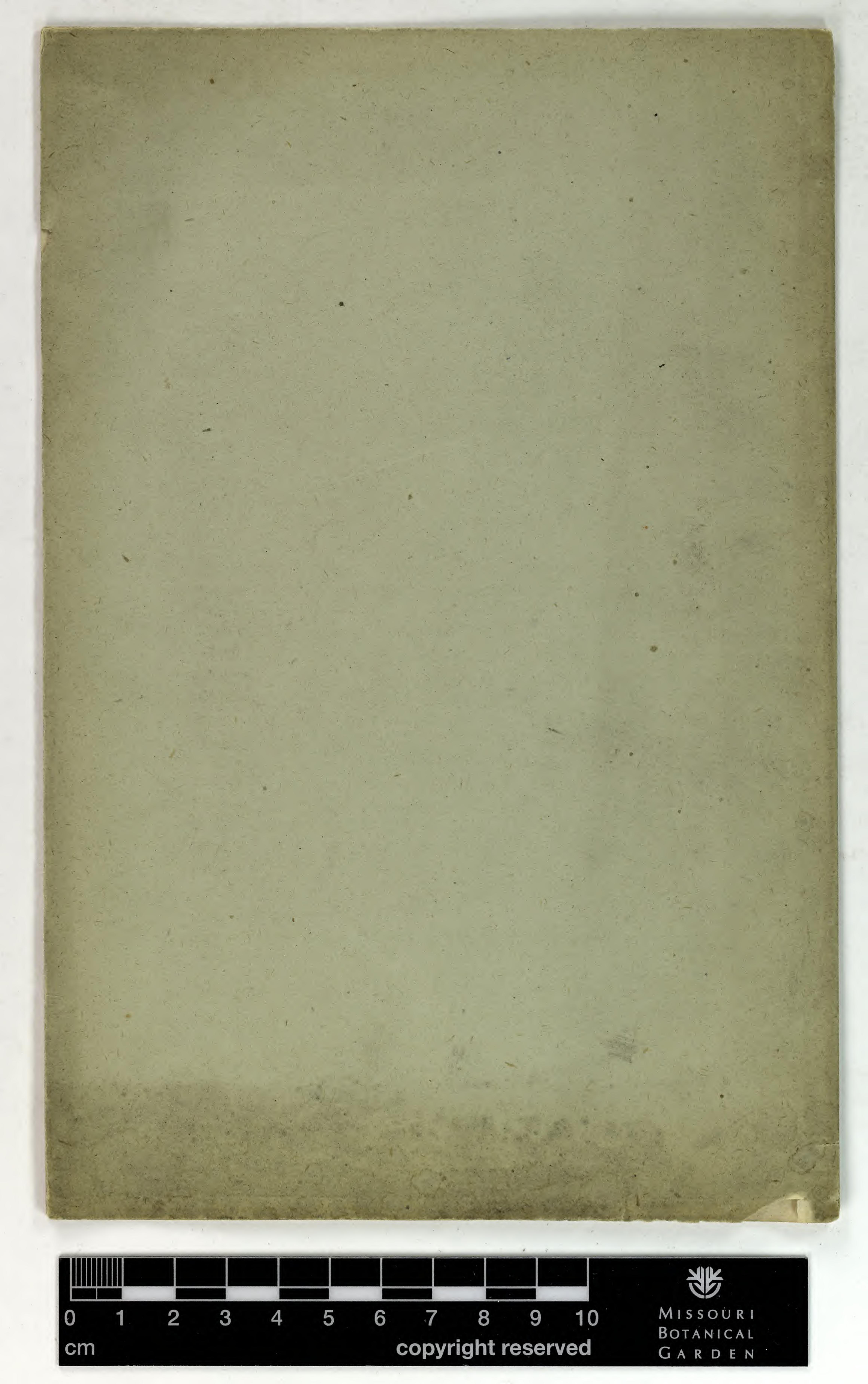


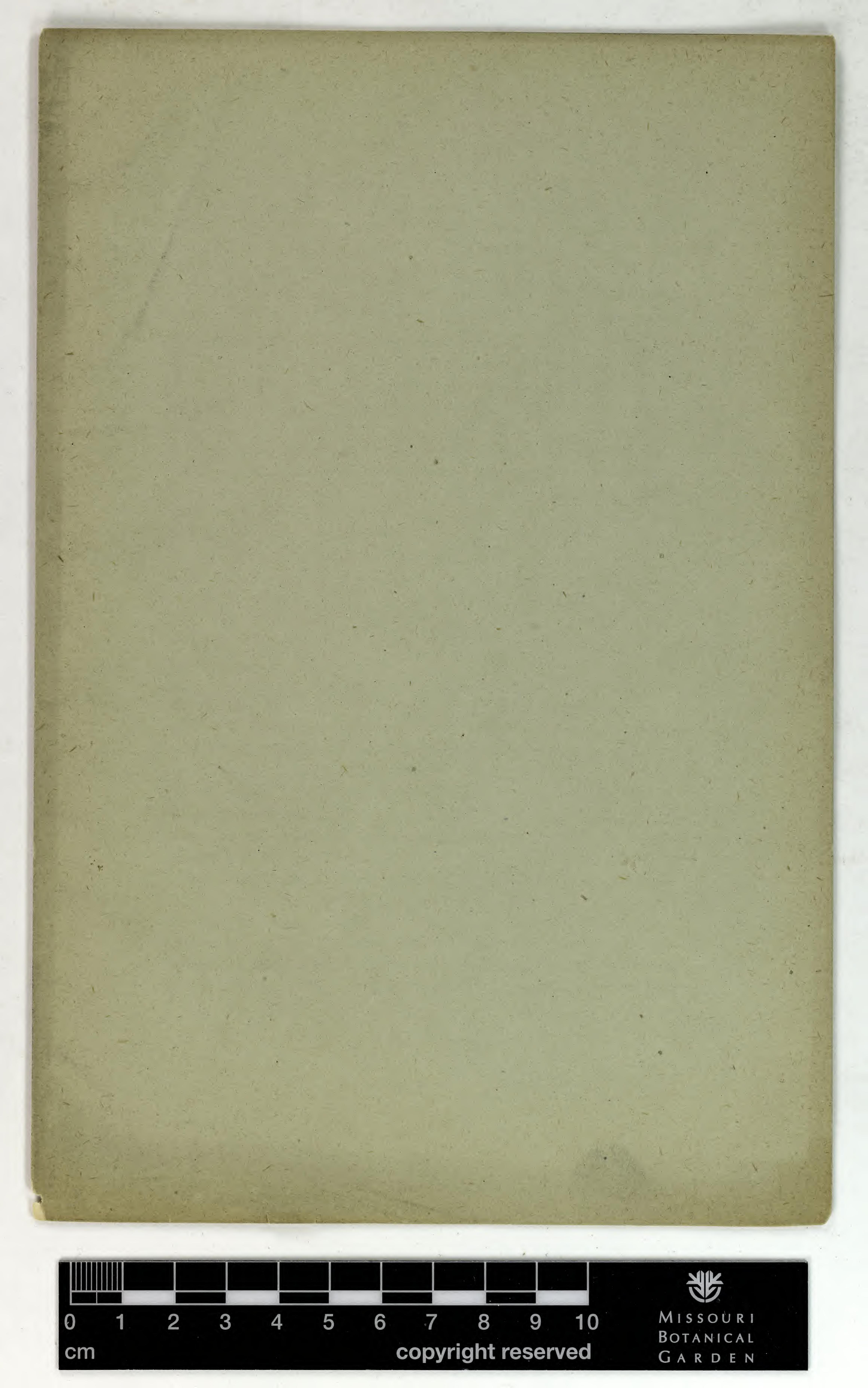
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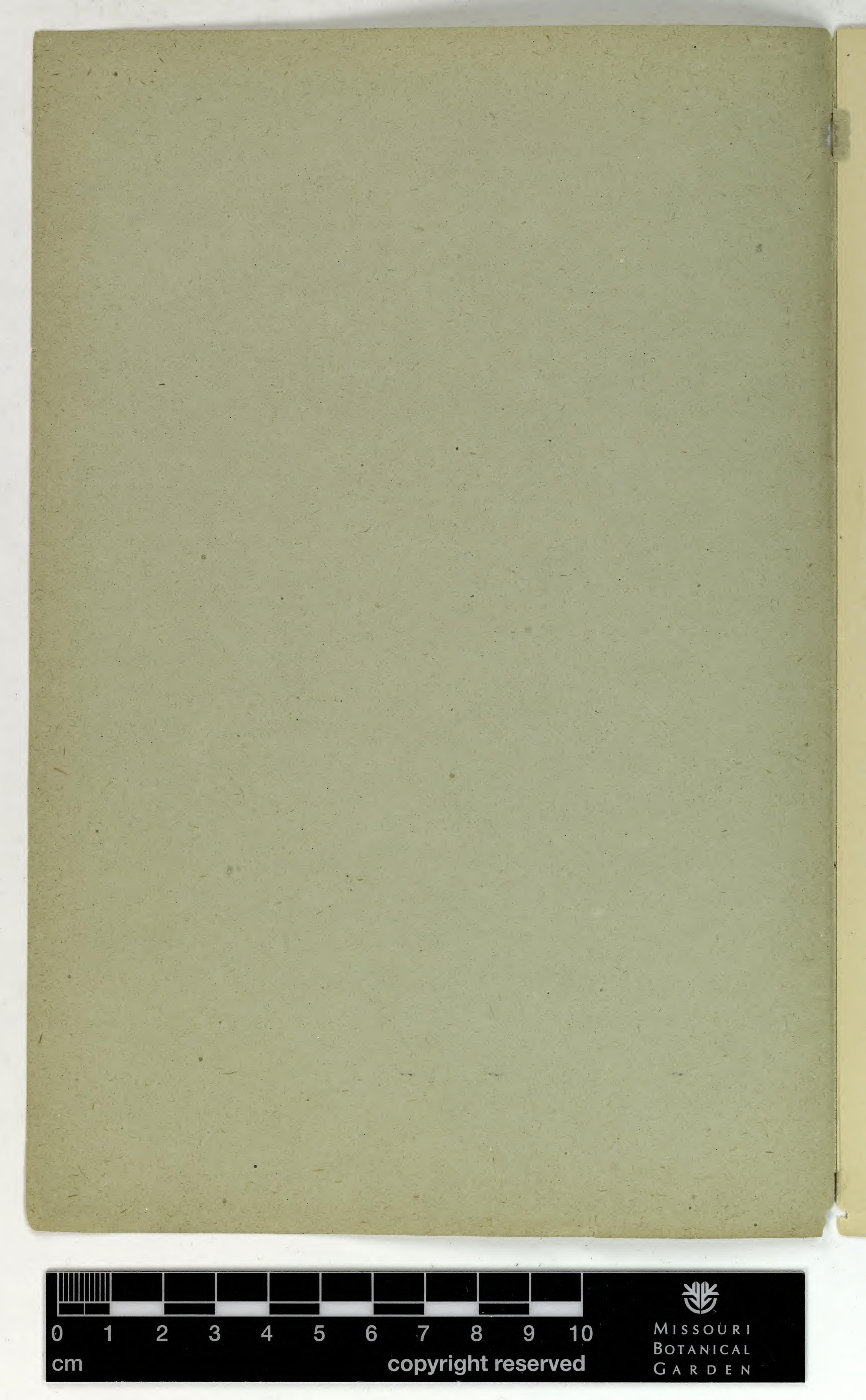
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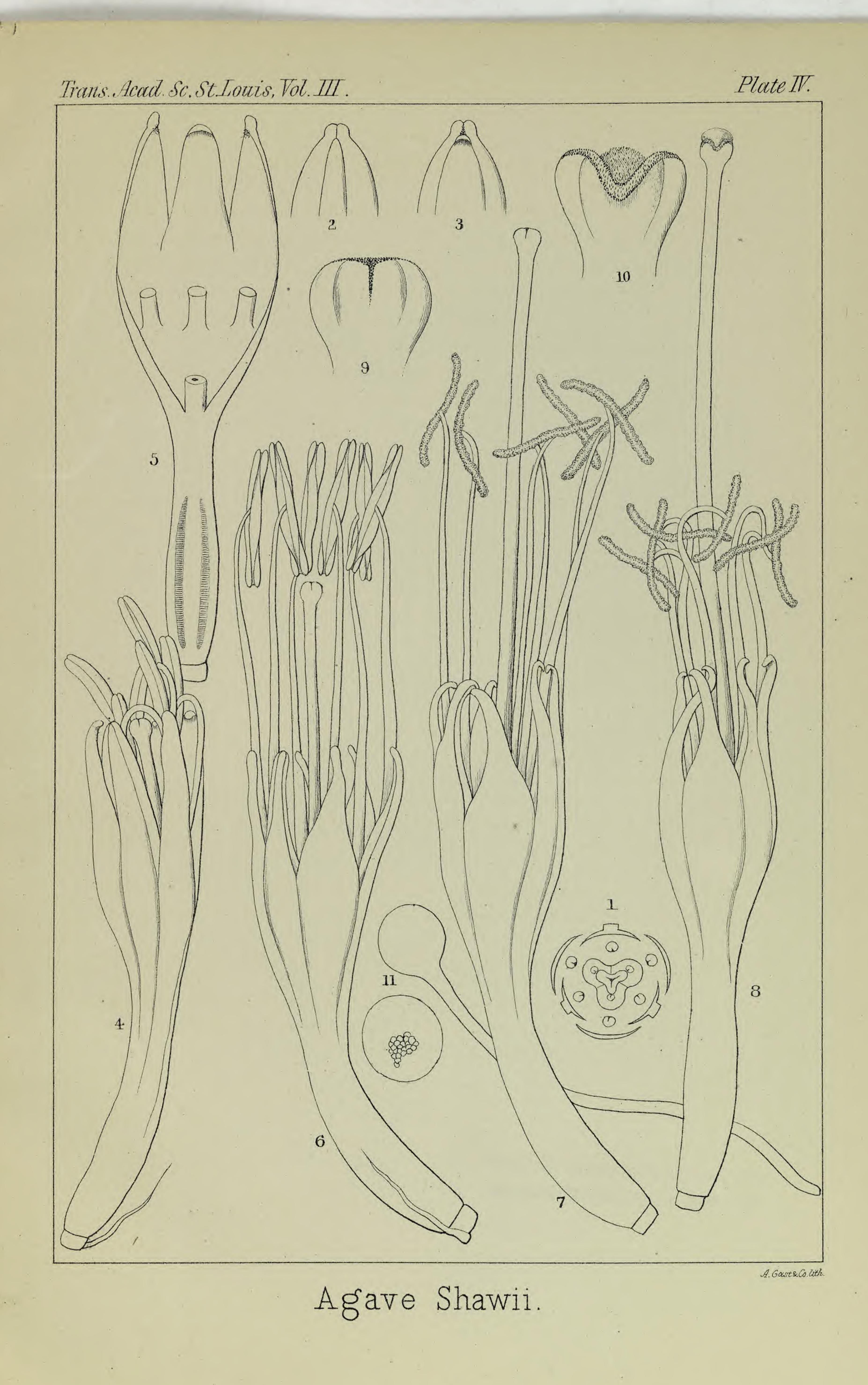
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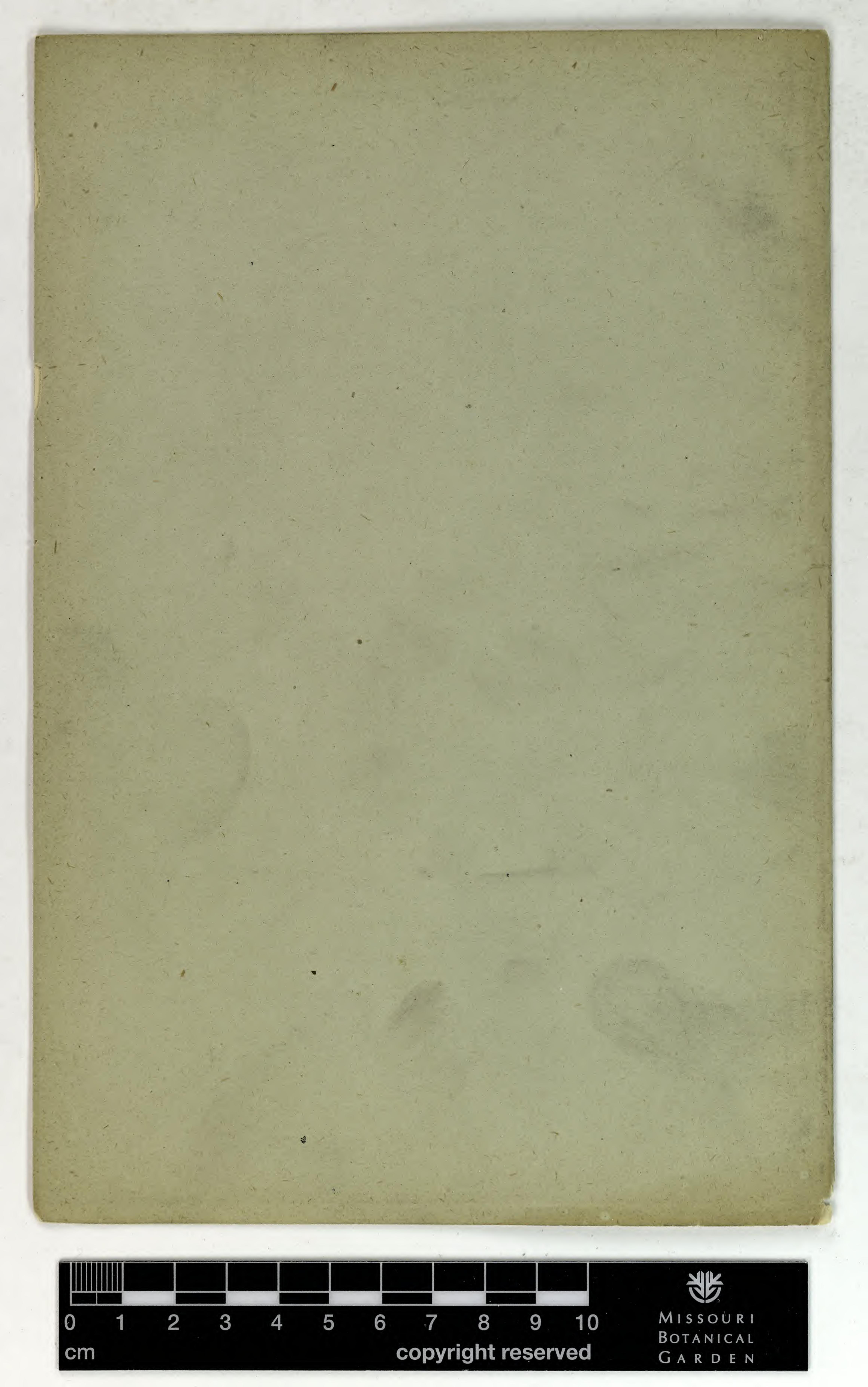






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DOMEST OF THE PARTY.	AMOUNT OF	FROWTH IN T	EN DAYS.	The state of the	
1876.	7 P.M7 A.M.	7 A.M7 P.M	Total.	Mean Temp.	Rainfall.
July 8-17	$3^{6}$ $4^{3}$ $7^{6}$ $7^{6}$ $7^{6}$ $7^{6}$	2 in. 2½ " 3½ " 4½ " 4 " 3 "	4\frac{3}{4} in. 5\frac{1}{4} '' 8\frac{1}{2} '' 9\frac{1}{4} '' 7\frac{1}{4} ''	82°.8 77°.4 69°.1 78°.3 79°.1 72°.6	1.26 in. 1.03 " 0.72 " 1.51 " 1.71 "
July 8-Sept. 5	27½ in.	19½ in.	46 <sup>3</sup> in.		

The table shows that the night-growth (including the morning hours) was in every decade larger than the day-growth, and in the whole period surpassed it by 16 p. ct., the former amounting to 58, the latter to 42 p. ct.

It is further seen that the largest advance was made about the middle period, or from the 3rd to the 5th, and mostly in the 4th decade. After Sept. 5th the growth diminished rapidly, about the end of the month the head began to swell, and 3 months later the first blossoms opened.

The table also proves that the temperature of each decade did not have any material effect on the growth of the stalk; in the warm weather of the first two decades it grew much less than in the cooler 3rd period.

[Nov., 1877.]



The largest growth in 24 hours, 1½ inches, took place in the 4th decade, Aug. 10th-11th, mean temp. 78°; while on Aug. 18th, with mean temp. 84°, the growth is marked only ½ inch, and Aug. 23rd and 25th, mean temp. 85°, it amounted to 1 inch and ¾ inch respectively.

The quantity of rain had apparently little or no immediate effect, as it was pretty evenly distributed through the whole period.

The full-grown scape measured 54 inches to the base of the panicle, which, when fully developed, was itself 21 inches long and a little wider, and consisted of 19 branches, the lowest ones the longest, somewhat S-shaped, and horizontal, with the end turned up.

About newyears the lower branches of the panicle, which thus far had formed a pointed club covered by the large bracts, began to straighten out, while the upper ones with their bracts yet formed a large cone. The first flowers opened on the lowest branch on Feb. 5th; the innermost ones of each cluster developed first, the others flowering in quick succession, so that all the flowers of a bunch were in bloom within about three days. Two or three weeks later the plant may be said to have been in fullest bloom, though the lower clusters were passed and the uppermost not yet open. These last flowered about March 18–20th, so that the flowering period (at this season and in a greenhouse) occupied from six to seven weeks.

Abundant opportunity was afforded to study the gradual development of the flowers (see also p. 298). I have, on Plate IV., represented these various phases by a series of figures carefully drawn from nature.

The bud bursts in the morning or in the middle of the day (Fig. 4); the bent filaments begin to straighten out, the still closed anthers commence to protrude, the top of the style has not yet reached the tip of the perigonial lobes. Only thus far the perigon and its lobes are fresh, exhibiting their fullest development.

In the evening of the same day the filaments are straightened out above the perigon, the anthers begin to open at the upper and lower ends, as Fig. 6 shows, and then all along their commissures; the style has not yet reached the length of the filaments, but the perigonial lobes are already withering at tip.



On the 2nd day the anthers are shrivelled, though quantities of pollen remain adhering to them; the perigon withers more; the style in the morning is still shorter than the filaments, but in the evening has exceeded their length somewhat; the stigmatic lobes remain entirely closed.

On the 3rd day these changes go on gradually and slowly. (Fig. 7.)

On the 4th the style is 2 inches longer than the perigon, the lobes of which are wilted and twisted, while the filaments also wither; in the evening the stigmatic lobes begin to separate and exude some moisture. The color of the flower, which at first was greenish and sulphur-yellow, now is of a deeper dirty yellow.

On the 5th day the style has reached its full development,  $2\frac{1}{4}$ —
2\frac{3}{4} inches longer than the wilted perigon; the filaments are drooping, the anthers shrivelled, much pollen yet adhering to them; the stigmatic lobes have separated and are covered with a large drop of sweet, glutinous stigmatic liquid, which causes the pollen grains that drop into it to develope their long tubes (Fig. 8).

The drop of stigmatic fluid remains fresh and full for another and often even a third day, and then gradually dries up; the functions of the flower are ended with the fertilization of the ovules.\*

I have not yet made mention of the abundant secretion from the nectariferous lower part (all the part below the insertion of the stamens) of the perigonial tube. During the several days in which the flowers were open the whole tube was filled to the brim with a sweetish watery liquid, of a slightly nauseous odor. I am not aware that such a secretion has before been observed in Agave flowers, and would now consider it as an abnormal phenomenon, originating under artificial circumstances, had not others, whose attention I had directed to such secretion, noticed the same in other species. Prof. C. S. Sargent, of Cambridge, Mass., saw it in an A. yuccæfolia which bloomed there last winter under glass, but could not find it in two specimens of the same species which in September flowered in the open air. Of greater importance, because made on a wild plant on its native mountains, is the observation of the Rev. E. L. Greene, who found last summer in



<sup>\*</sup> Buds or flowers that are kept for a while separated from the plant, such e.g. as are sent fresh by mail, become distorted, the ovary swells, the style lengthens, but the perigon and stamens wither even if not yet fully developed.

Southwestern New Mexico the large paniculate Agave Parryi so loaded with this liquid that it actually rained on him when he knocked on the stalk, or when the wind shook the panicle. South European botanists, who have numerous cultivated species and especially the naturalized A. Americana at their disposal, are in a position to investigate and experiment upon this curious physiological fact. Our A. Virginica exudes only a small quantity of honey in the base of the tube, but nothing like such a watery abundance.

#### EXPLANATION OF PLATE IV.

- Fig. 1. Diagram of the flower. Three exterior lobes of the perigon cover the thin margins of the 3 interior ones; 6 stamens opposed to the lobes; 3 carpels opposed to the 3 exterior lobes, each with two series of ovules; in the centre the stigma, its 3 lobes alternating with the carpels.
- Fig. 2. Top of the flower-bud, showing one interior between two exterior lobes.
- Fig. 3. The same, inside, exhibiting the broader hood of the inner lobe between the longer and narrower outer ones, all of them downy below the tip.
- Fig. 4. An opening bud in the forenoon of the first day; the filaments begin to straighten, raising the anthers, appa rently in irregular order, above the perigon; style quite short.
- Fig. 5. Section of the same, with style and filaments cut off; the perigon is seen in full development before it begins to wither; insertion of the filaments in the middle of the tube, the inner one slightly lower than the outer ones.
- Fig. 6. Flower fully open on the first evening: filaments straight; anthers opening at the upper and lower end; style not yet of the length of the filaments.
- Fig. 7. Flower on the third day: anthers and perigon shrivelling, filaments yet erect; style of nearly full length; stigma yet closed.
- Fig. 8. Flower on the fifth day: perigon and filaments wilted; style fully developed, stigmatic lobes separated and bearing a large drop of glutinous liquor.—All these figures in natural size.
- Fig. 9. Stigma closed.
- Fig. 10. Same with expanded lobes, both magnified 4 times.
- Fig. 11. Pollen grains magnified 100 times: one intact, slightly elliptic; the other, developing its tube and somewhat contracted.



Agave Shawii.

A. Gowt & Co. lith.

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